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Amphiploid Seed Obtained by Colchicine Treatment of an F_1 Hybrid Between *Triticum spelta* and *Agropyron intermedium*

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Summary

An F_1 hybrid plant obtained from a combination that *Triticum spelta* var. *duhamelianum* as female crossed with *Agropyron intermedium* as male was treated with colchicine solution with DMSO as described by WINKLE and KIMBER in 1976. Despite the treatment made under relatively low temperature of early spring, effectiveness of the treatment is evident, because two out of ten plants had a spike with sector of doubled chromosome and several good seeds were obtained from one spike.

Also the result indicated that the self-compatibility of the wheat parent is epistatic to the self-imcompatibility of *Ag. intermedium*.

Introduction

Importance of *Agropyron* species as a useful genetic resource in the wheat breeding has long been well known[1]. Without having any genome common with species of wheat, the F_1 from the combination that an *Agropyron* species crossed to wheat, *Triticum*, shows high sterility, and then naturally progeny plants in the backcross generation, if any obtained in low frequency, may involve some chromosome rearrangement due to homoeologous pairing between the chromosomes of the parents. Thus, for the production of a series of monosomic addition lines that the *Agropyron* chromosomes added to wheat, an amphiploid strain between the two genus is highly effective and enable us to produce the lines with an intact *Agropyron* chromosome.

An effective colchicine treatment method to double the chromosome number, which described by WINKLE and KIMBER in 1976 [2], was applied to an F_1 hybrid plant between *Triticum spelta* var. *duhamelianum*, and the result obtained is reported here.

Materials and Methods

A hexaploid wheat line, *Triticum spelta* var. *duhamelianum* ($2n=42$, AABBDD), which received from the Plant Germplasm Institute, Faculty of Agriculture, Kyoto University and maintained for years at Okayama, is used as a wheat parent. A strain of *Ag. intermedium* ($2n=42$) used as an *Agropyron* species to cross with wheat was received from Late Dr. Seiji MATSUMURA. Since the strain is completely self-imcompatible, it has been maintained vegetatively for more than 35 years.

For the colchicine treatment of the hybrid, one F_1 plant with many tillers was selected and washed the soil and divided into the number of plants by separating tillers. Therefore, the plants obtained had two to three tillers of various size. Then they were left for a few days for initiating new buds and roots before treating with colchicine. The treatment was made by immersing the root part of the plants into a solution of 0.05% colchicine in 1.5% DMSO (dimethyl sulfoxide) for seven hours. After the treatment, they were planted to the soil in a small container placed outside the green house and were covered with a sheet of wet paper for avoiding withering of the plants. After the plants showed to have new tillers they were transplanted to the field of the

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Results and Discussion

1. Chromosome doubling

The plants that were treated with colchicine showed apparent delay of their initial growth. However, they soon began to show normal growth and then developed many tillers. As in an F_1 plant withouthe treatment, they started to have spikes by June.

Since the treated plants tillered profusely, each individual plant had more than thirty spikes by the end of June and spike heading continued throughout summer to early September. Because of the facts that there is not any genome common between the parent species and that, as in previous reports by several authors, high irregularity with some polyvalents and univalents besides bivalents, many of which paired with a terminal chiasma, was found at MI, chances to have any formation of a normal gamete are extremely low.

Naturally pollen sterility is expected in anthers of the F_1 without doubling the chromosome number, and so did all of normal untreated plant. In the treatment plot, however, two out of 10 plants had a spike with several flowers of which anthers shed pollen. In one spike both male and female sides had apparently the doubled chromosome number, for the flowers set good seeds. In another spike, however, seed was not obtained.

Besides these two spikes that had clear fertile sector, some anthers among the rest of the flowers shed pollen. That the flowers with such an anther were only found sporadically among plants indicated that the spikes do not have any appreciable amount of sector of fertile part.

In any spike of the treated plants that headed in the later season, there was not any anther that shed pollen. Since the treatment was made under relatively low temperature of the early spring, that is, about 10−15 ℃, any high degree of the chromosome doubling was not expected. Nevertheless, that the spike with the appreciable sector of doubled chromosome was found in 20% of the treated plants shows relatively high effectiveness of the treatment. That among them only one spike per each plant had the clear sector and that the chromosome doubling was not obtained in spikes headed later indicated that only the primodial tissue in young tiller at the time of the treatment received the chromosome-doubling effect.

2. Self compatibility

Another important indication in the present experiment is that the self-compatibility of *T. spelta* is epistatic in effect over the imcompatibility that is shown by *Ag. intermedium*, although genetic system involved was not known.

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References

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コルヒチン処理によるコムギとカモジグサ属の一種, *Agropyron intermedium*, との複二倍体種子の育成

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カモジグサ属 (*Agropyron*) とコムギとの間の複二倍体系統の育成のため，普通系コムギの1種，*Triticum spelta* (2n＝42)，に *Ag. intermedium* (2n＝42) を交配し，得られた交雑 F_1 植

物のコルヒチン処理を行った．対照区では F_1 植物はすべて不稔であったが，処理区では10個体中2個体でそれぞれ1穂計2穂が染色体数の倍加による稔性部分を示し，1穂では数粒の良好種子が得られた．処理はWINKLEとKIMBER(1976)の方法により，3月下旬の室温10－15℃の条件下で比較的低温であったが，20% の個体で倍加が生じたことは従来の方法に比べて極めて高い効果を示したといえる．

また，このように種子が得られることは，*Ag. intermedium* の自家不和合性に対し，*T. spelta* の自家和合性形質が上位として表われることを示している．